D Y 1-13

PATENT SPECIFICATION

(11) 1 550 080

1 550 080

(21) Application No. 39765/77 (22) Filed 23 Sep. 1977

(31) Convention Application No. 7610699 (32) Filed 28 Sep. 1976 in

(33) Sweden (SE)

(44) Complete Specification published 8 Aug. 1979

(51) INT. CL.^{2} F16L 55/04

(52) Index at acceptance

G3P 1C 24X F1D P18A

(19) THE PATENT OFFICE LONDON

(54) IMPROVEMENTS IN AND RELATING TO REGULATING THE FLOW OF FLUIDS IN A PIPE

(71) We, TETRA PAK INTERNATIONAL AB, a Swedish corporate body of Fack S-221 01 lund 1, Sweden, do hereby declare the invention of which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to pipe means for transmission of fluids, and is suitable, for example, for supplying a liquid, such as milk, to packaging means for intermittent delivery containers.

In connection with intermittent flow of liquids in pipes pressure shocks caused by the sudden checking of the flow introduce a problem which is difficult to solve. Several solutions have been proposed, and they have in some cases given satisfactory results. However, within the dairy technology the problem is as yet awaiting its final solution. This, among other reasons, is due to the fact that the very stringent hygienic requirements in connection with handling of foodstuffs exclude the utilisation of pressure shock relief and flow regulating devices used in other fields.

Any device for flow control or pressure regulation in handling foodstuffs should be of simple and uncomplicated design, but robust, easy to clean and sterilize, and should occupy minimum space.

It is an object of the present invention to provide pipe means incorporating means for reducing or eliminating shocks which meet the aforesaid requirements.

In order to absorb the energy of shocks originating from the intermittent arrest of flow of fluid in a pipe there may be provided an expansible, resilient chamber associated with the pipe, adjacent to and upstream of, a repeatedly-operated valve which controls the intermittent flow. This is effective in suppressing shock waves originating at the valve and transmitted along the pipe in a direction counter to the liquid flow. However shock waves may also be transmitted through liquid in the pipe from the in-flow side and in the direction of flow of liquid, and if such shocks coincide with those originated by the valve damage may be caused to the expansible chamber.

Bearing this danger in mind the invention consists in a liquid-conducting pipe incorporating a control valve adapted to be operated repetitively in order to allow intermitten passage of liquid wherein a chamber of variable volume is incorporated in the pipe adjacent to and upstream of said valve, and adapted by volume variation to reduce or eliminate the shock effects in the line caused by the repeated interruption of liquid flow by said valve, means for sensing pressure variations in the pipe upstream of said chamber and means under control of said sensing means for maintaining substantially equal pressures internally and externally of said chamber.

The expansible chamber may be in the form of pipe of flexible material, or an inflatable bladder in the pipe. The volume of the pipe or bladder may be controlled by gaseous pressure, e.g. air pressure, acting counter to the pressure of fluid flowing through the pipe, so that a shock wave in the flowing fluid is absorbed by change of volume of the chamber due to momentary yielding of the gaseous pressure. The gaseous pressure may be controlled by a sensor of fluid pressure in the pipe upstream of the chamber adapted to regulate passage of compressed air from a reservoir to equalise pressures internally and externally of the chamber.

The invention will now be described in greater detail, by way of example, with reference to the accompanying schematic drawings, wherein

Figure 1 shows schematically a form of the invention suitable for use, for example in a pipe for the supply of milk to a packaging machine which intermittently fills pre-formed containers with milk;

Figure 2 shows an enlarged section through a part of the device shown in Figure 1, the figure being divided into left hand and right hand

Express Mail No.
EV195875733US

halves showing the device in two different operating positions;

Figure 3 shows a section through another embodiment of the unit shown in Figure 2.

In Figure 1 the device according to the invention is shown as set up for use in a dairy where a main pipe 1 supplies a number of packaging machines with milk. The supply to only one machine is shown. From the main pipe 1, the milk is led by a secondary pipe 2, to an individual packaging machine, and as indicated the main pipe 1, may supply a large number of individual packaging machines with milk. The milk is supplied to the main pipe from a tank 3 by a pump 4, which continuously pumps the milk through the main pipe, and the flow through the main pipe 1 is greater than the greatest possible total take-off through all the secondary pipes 2, so that part of the milk in the main pipe 1 is returned to the tank 3, through a return pipe 5. Each secondary pipe 2 runs from the main pipe 1 to a packaging machine (not shown) and is equipped with a stop valve 6, located immediately upstream of the packaging machine, or in the packaging machine. The valve 6 is controlled by the packaging machine in such a manner that it opens and admits a pre-determined quantity of milk from each pack. As an example it may be mentioned that in the case of a commonly used packaging machine the valve is opened every two seconds, and is open for 0.4 second each time. Even higher frequencies occur, and because both the opening and the closure of the valve must take place very rapidly, unavoidable pressure shocks occur in the secondary pipe on the counter-flow side of the valve. In order to absorb these pressure shocks, and to prevent their propagation along the secondary pipe back to the main pipe 1, a device 7, referred to hereinafter as a compensator, is incorporated in the secondary pipe 2 immediately upstream of the valve 6. The compensator 7 shown in Figure 2, comprises a chamber for passage of milk and a chamber for a fluid under pressure, the chambers being adjacent to one another and separated by a common flexible resilient wall through which each change of volume of one chamber results in a corresponding and opposite change of volume of the other chamber. Preferred embodiment of the compensator will now be described in more detail with reference to Figures 2 and 3.

The chamber in the compensator 7, which is intended for pressure fluid (usually compressed air) is connected by way of a pressure regulator 8, and also if desired by way of a tank 9 for pressure fluid, to a source 10 of fluid under pressure, which may be a conventional compressor for producing compressed air. The pressure regulator 8 maintains the pressure in the chamber for pressure fluids in the compensator (and in the tank 9, if any) at a prearranged level, depending on a signal from a sensor or pressure transmitter 11, which may be of pneumatic or electrical type, and is connected to the secondary pipe 2 upstream of the compensator 7, in order to gauge the pressure changes which occur therein, e.g. when other packaging machines which are connected to the main pipe are being stopped and started by their valves 6.

The compensator 7, shown in Figure 2, comprises, as already mentioned, two chambers, i.e. a first chamber 12, to which the secondary pipe 2 is connected, and through which the milk flows, and a second chamber 13 which is connected to the compressed-air source 10. The second chamber 13 is annular and is defined by a pipe 14 surrounding the tube 15, which defines the chamber 12 and is coaxial with the pipe 14 and is made of flexible resilient material, e.g. rubber. Each end of the pipe 14 is closed by a disk 16 formed with a centre hole 17 in which the relevant end of the rubber tube 15 is inserted. Each hole 17 has a cylindrical flange 18 and a conical chamfered edge. The cylindrical flange 18 extends inwardly of the tube 14 and the chamfered conical edge of the hole 17 faces outwards. This design of the flange 18 and the hole 17 facilitates the firm and safe fastening of the relevant end of the tube 15 in the disk 16. As shown in Figure 2 the end of the tube 15 is flared and turned back upon itself (e.g. around a rigid ring) so that it has a double-walled end zone located in the conical part of the hole 17 and extends somewhat beyond the end face of the disk 16. A union nut 19, screwed on to the disk 16, holds the end flange of the secondary pipe 2 against the face of the disk 16, thus clamping the end of the tube 15 in position. As the tube 15 in this manner is connected in series with the secondary pipe 2 it constitutes a flexible resilient section of the secondary pipe, through which the milk flows freely. The tube 15 is made of a particularly flexible type of rubber, and may be expanded substantially without bursting if the pressure increases inside the pipe. In order to prevent too much expansion of the tube a mechanical limiting guard 20 is installed around the tube 15, i.e. located in the annular second chamber 13 and retained between the protruding flanges 18 of the two disks 16. The guard 20 shown is a spool-shaped metal cylinder, the wall of which is provided with a large number of holes so that air may flow freely into and out of the guard. The compensator 7 is connected by an opening to a pipe 21, by which the second chamber 13 is connected to the pressure fluid source 10 through the pressure regulator 8 (Figure 1).

During operation, as already mentioned, a constant flow of milk is pumped through the main pipe 1, and as packaging proceeds at the various packaging machines the relevant valve 6 opens for a brief moment to let through the desired quantity of milk. The pressure in the secondary pipe 2 may thus rise and fall suddenly. If only a single packaging machine is

operating, or if only a single packaging machine is connected to the system, the pressure shocks which occur when the valve 6 is closed are in the main of the same magnitude each time. By means of the compensator 7, connected in series with the secondary pipe 2 immediately upstream of the valve 6, the pressure shocks are largely absorbed because each sudden pressure rise in the secondary pipe 2 results in a corresponding volume increase in the flexible rubber tube 15, which expands against the counter effect of the air pressure inside the second chamber 13. By adjusting the valve of this air pressure to the anticipated extent of the pressure shocks in the secondary pipe, the pressure shocks can be substantially equalised. From the tank 9, connected by the pipe 21 to the second chamber 13, the volume of air available is several times larger than the volume of the chamber 12, so that the changes of volume of the chamber 13, caused by the movement of the flexible rubber tube constitute only a fraction of the total volume of the chamber 13 and the tank 9, for which reason the pressure in the chamber 13 (and the tank 9), remain substantially constant regardless of the momentary increase in volume of the chamber 12.

Normally a number of packaging machines are connected to the same main pipe 1, and as they may be started and stopped regardless of one another the pressure in the pipe may vary substantially and at random. In other words, it is impossible to predetermine the liquid pressure which will prevail in the secondary pipe 2 at the moment any one valve 6 (e.g. the valve 6 shown in Figure 2) closed. If the air pressure in the second chamber 13 is not adjusted to a corresponding degree, the resistance to the expansion of the tube 15 due to the pressure shocks is liable, consequently, sometimes to be too great and sometimes too small, and may damage the tube 15. In order to meet this danger, the pressure in the second chamber 13 is adjusted by the pressure regulator 8, which regulates the air flow from the pressure source 10 in accordance with a signal from the sensor or pressure transmitter 11, which gauges the pressure in the secondary pipe 2 upstream of the compensator 7. An increase of the pressure, (e.g. due to the start of another packaging machine), causes the pressure regulator to increase the pressure in the second chamber 13 to a corresponding degree, so that the force countering expansion of the tube 15 is adjusted to conform with the pressure in the pipe 2 upstream of the compensator. On the other hand, the pressure transmitter does not react to the small and rapid variations in pressure which may occur in the secondary pipe due to the operation of the valve 6 of the machine which it feeds because these variations are substantially completely equalised by the compensator 7 in the same line. In order to ensure correct gauging, the pressure transmitter 11 may either be located at a relatively great distance upstream of the compensator 7, or be adjusted so that it only reacts to substantial pressure variations.

The compensator may be of various forms while retaining the principle of two chambers separated by a common moveable wall. Another such embodiment of the compensator is shown in Figure 3. This compensator 22 comprises a first chamber 23 which as before constitutes a channel for fluid flow through the compensator, connected in series with the secondary pipe 2. Each end of the first chamber 23 has a diameter corresponding to the diameter of the secondary pipe 2 while the intermediate length of the first chamber 23 is of substantially greater diameter. The transition between the two different diameters is gradual, and the chamber 23 may conveniently be spool-shape, for smooth liquid flow.

A second chamber 24 is located centrally in the first chamber 23, and is shaped as a length of tube or a rubber bladder 25 closed at one end and connected by the opposite end to a pipe 26, which extends out through the wall of the compensator 22 and is connected to a source of compressed-air to be supplied to the inside of the second chamber 24. The spool-shaped rubber bladder 25 is made of the same highly flexible resilient material as the tube 15 in the previously described embodiment of the compensator, and each change of volume in one chamber results in a corresponding and opposite change of volume of the second chamber. The inner wall of the first chamber 23 serves to limit the expansion of the rubber bladder.

The compensator 22 functions in the same manner as previously described with reference to compensator 7. However, due to its design it requires less space and may, therefore, be used to advantage where space is limited. On the other hand, it is a disadvantage that it is somewhat more difficult to clean. However, this disadvantage may to some extent be compensated for by cleaning with a through-flowing cleaning agent, while alternately inflating and deflating.

Both embodiments of the device according to the invention are however simple to clean and sterilise at the same time as the pipe for fluid supply to the packaging machine, because the cleaning and sterilising agent can flow quite simply through the compensator. Both the actual compensator and the entire device for regulating the liquid flow are of simple and uncomplicated design which ensures good operating reliability and has been found to work in a particularly effective manner.

WHAT WE CLAIM IS:—

1. A liquid-conducting pipe incorporating a control valve adapted to be operated repetitively in order to allow intermittent passage of liquid wherein a chamber of variable volume is incorporated in the pipe adjacent to and upstream of said valve, and adapted by volume variation

to reduce or eliminate the shock effects in the line caused by the repeated interruption of liquid flow by said valve, means for sensing pressure variations in the pipe upstream of said chamber and means under control of said sensing means for maintaining substantially equal pressures internally and externally of said chamber.

2. A pipe as claimed in claim 1 wherein said chamber is formed with a wall of yieldable, resilient material.

3. A pipe as claimed in claim 1 or 2 wherein said chamber is in the form of expansible resilient tube fitted as part of the feed line to said valve.

4. A pipe as claimed in claim 1 or 2 wherein said chamber is in the form of an inflatable resilient enclosure mounted inside a rigid pipe through which liquid passes to said valve.

5. A pipe as claimed in claim 3 or 4 comprising means adapted to limit expansion of said chamber if excessive pressure difference should arise on opposite sides of the resilient wall thereof.

6. A pipe as claimed in claim 5 when appendant to claim 3 wherein said limiting means comprise a rigid cage-like enclosure surrounding the expansible resilient tube forming the chamber.

7. A pipe as claimed in claim 5 when appendant to claim 4 wherein said inflatable enclosure is located inside a rigid surround of enlarged diameter through which the liquid flows, and which serves as a guard to limit expansion of said enclosure under inflation.

8. A pipe as claimed in claim 3, or in any of claims 4 to 7 when appendant to claim 3 wherein said length of expansible tube, and its expansion guard, if provided, are surrounded by a rigid gastight casing.

9. A pipe as claimed in claim 7 or 8 comprising means for supplying fluid under pressure to the enclosure surrounding, or to the interior, of said chamber, in order to equalise the liquid pressure applied to the other face of the chamber wall.

10. A pipe as claimed in claim 9 comprising an enclosure of substantial capacity holding a gas under pressure, and regulator means for controlling release of said gas under pressure to equalise internal and external pressures on said chamber wall.

11. A pipe system comprising a plurality of pipes as claimed in any preceding claim connected as branch pipes to a common main liquid supply line.

12. A pipe system as claimed in claim 11 wherein said branch pipes are separately connected, as supply lines, to individual liquid packaging machines.

13. A pipe installation with shock-wave suppressing means, substantially as described herein with reference to the accompanying drawings.

W. H. BECK, GREENER & CO.,
Chartered Patent Agents,
7, Stone Buildings,
Lincoln's Inn,
London WC2.

Agents for the Applicants.

Printed for Her Majesty's Stationery Office by MULTIPLEX techniques ltd., St. Mary Cray, Kent. 1979. Published at the Patent Office, 25 Southampton Buildings, London WC2 1AY, from which copies may be obtained

1550080 COMPLETE SPECIFICATION

1 SHEET This drawing is a reproduction of the Original on a reduced scale

Fig. 1.

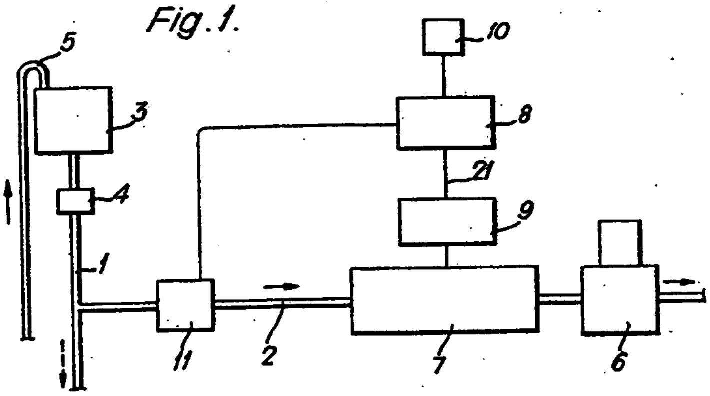

Fig. 2.

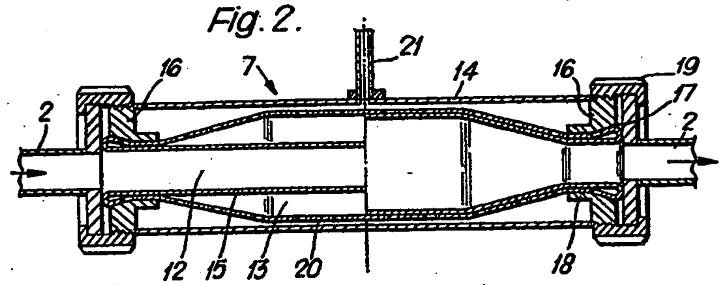

Fig. 3.